"TESTS OF KANSAS CEMENTS AND CONCRETES"

BY

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In all modern building and construction work there is a demand for some material which will not soon wear out, one which is also fire proof and something which is also water proof. To answer all of these requirements, many things have been tried but none seem to stand the tests which the ordinary cement and concrete do.

When pure or nearly pure limestone is calcined to drive off the carbondioxide an oxide of lime commonly called quicklime is formed, which upon the addition of water will slack causing heat and resulting in a fine powder and if still more water be added resulting in a paste from which is made the common mortar which will set only in air. By setting is meant that process which a substance undergoes after being mixed with another, usually water, before it attains its final form and hardness.

If the original limestone contains also a small per cent of clay or silica the product will slack due to the free lime present and in addition will set under water. This is called hydraulic lime.

Hydraulic cements differ from limes in that they contain enough impurities that the slacking is negligable and that they will set under water. Hydraulic cements may be divided into three classes as follows: (1) Natural (2) Portland (3) Pozznolana. Which will be taken up in order. The first two differ from the third in that they require a process of calcination.

NATURAL CEMENTS.

Natural cement is made from a natural carbonate or magnesian limestone. The stone is calcined or burned at low temperature to a clinker; this is crushed and ground very fine. The product is of a brownish color and is what is commonly called "Natural

Cement" by the commercial world. This upon the addition of from twenty-five to thirty-five per cent of its weight of water, hardens very quickly and produces an artificial stone which constantly strengthens with time. The stone from which this was first made was found near Rosendale, New York, and the cement was called Rosendale cement. It is now found quite extensively in the United States and Europe. In the United States it is found in New York, Maryland, Kentucky, Kansas, and several other states; but we take into consideration only one from Kansas known as the "Fort Scott Natural" and one from Kentucky known as the "Louisville Natural".

PORTLAND CEMENT.

Portland cement is known as an artificial cement because the carbonate of lime is mixed artifically with clay before calcination. The materials being first ground to a powder before mixing. The mixture, consisting usually of from 20% to 23% of clay and from 75% to 80% of carbonate of lime, after being dried is broken up and burned at a temperature sufficiently high to cause a chemical combination of the silica and aluminum of the clay with the lime. The result of this calcination is broken up and ground. Portland cement is slower setting than the natural cement but it ultimately acquires more strength. It is of a gray or greenish gray, the bluish gray shows excess of lime while the brownish shows excess of clay.

POZZNOLANA

Pozznolana is a term applied to a combination of silica and aluminum which when mixed with common lime and made into mortar will harden under water. It is usually of volcanic origin and will not be dealt with in this article.

METHODS OF TESTING.

The value of a cement varies greatly with the chemical composition, the temperature of calcination, and the fineness of grinding and a slight variation of these may greatly affect the physical properties of the product.

The properties to be examined to determine the value of a cement for construction purposes are; (1) Color (2) Fineness (3) Thoroughness of burning (4) Soundness (5) Rate of setting (6) Strength. Of these the ones which are of the most importance are strength, color, and rate of setting. Of these latter, strength comes first, as it is by far the most important, with the rate of setting next.

It is important to know how soon after mixing with water to a plastic state a cement will begin to set, as its strength is seriously impared if it be disturbed after the setting has begun. The cement is mixed with water to a stiff plastic mortar and a pat is made of from two to three inches in diameter and one half inch thick. The mortar is said to have begun to set when it will just support a wire one twelfth inch in diameter and weighing one fourth pound, and to have set hard when it will bear a wire one twenty-fourth inch in diameter and weighing one pound. The time between the time of the addition of the water to the time of the supporting of the first needle, is said to be the time of beginning to set, while the time between this and the time of the supporting of the second needle, is the time of setting. It is ordinarily sufficient to say that mortar has begun to set when it has lost its plasticity and has set hard when it will resist a slight pressure of the thumb nail.

The strength of cement and cement mortar is usually determin-

ed by testing a small portion of the cement made into a briquette. The briquettes are made as follows: Determine first the porportions to be used in the mixture if it be sand and cement, have them thoroughly mixed before adding any water. When the water is added it should be added all at once. The mortar being well worked after the addition of the water to insure a uniform degree of moisture for all particles of cement. It is then put into the moulds. The moulds are made of some non-absorptive material. The moulds are of two types, compression and tension. The compression mould is made so as to make a briquette 2 x 2 x 2 inches or a two inch cube. The tension briquette mould is of such a shape as to give a minimum cross section farther out in order to be able to fasten the clamp which breaks it. The sides of the moulds should be well oiled to prevent the sticking of the mortar to the side of the mould.

After the addition of the water and the thorough mixing of the mortar, it is placed in the moulds, being well packed in order that there will be no air holes. The briquettes, being made on some non-absorptive material, are placed in some spot where the atmosphere is damp and allowed to remain there for twenty-four hours when they are taken from the moulds and placed in water to remain until time to be tested. Cements are usually tested in tension as that usually gives the correct indication of the compressive strength and it requires a smaller machine to do the work. Cements are tested after 1 day, 7 days, 14 days, 28 days, etc.

Concretes consist of a mixture of cement, sand, and some other substance which is hard and rather bulky, crushed stone being preferred, but gravel and cinders are also used. Concretes being nearly as strong as stone, being fire proof, and much more easily procured, it has come to take the place of stone almost universal-

ly. Concrete is made of various mixtures, the larger the per cent of cement the "richer" the concrete is said to be and also the richer the concrete the stronger it will be. Some of the most common mixtures are as follows: 1 cement; 2 sand; 3 stone (exceeding rich) (2) 1 cement; 3 sand; 5 stone (common) and 1 cement; 4 sand; 7 stone.

The methods of testing concrete are: compression and tension by means of the transverse test. In the transverse test the tensile strength is found from the modulus of rupture of the concrete beam by means of the following formula:

$$f = \frac{M\,Y}{I}$$

In which:

f = modulus of rupture

M = bending moment of the section = breaking load X amm

Y = distance of most strained fibre from neutral axis

I = moment of inertia of the section

KANSAS PORTLAND

A - Test in Tension.

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength Lbs. sq.in.	Remarks
1	21.8%	78.2%	Feb.4	Feb.11	7	252	
2	"	"	"	"	"	346	
3	"	"	"	"	"	289	
4	"	"	"	"	"	200	
5	"	"	"	"	"	Lost	
Average	"	"	"	"	"	272	

A - Test in Tension

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs. sq.in.	Remarks
1	21.8%	78.2%	Feb.4	Feb.11	7	312	
2	"	"	"	"	"	286	
3	"	"	"	"	"	264	
4	"	"	"	"	"	237	
5	"	"	"	"	"	Lost	
Average						275	

A - Test in Tension

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	22%	78%	Jan.27	Feb.15	19	510	
2	"	"	"	"	"	522	
3	"	"	"	"	"	440	
4	"	"	"	"	"	545	
5	"	"	"	"	"	565	
Average						516.2/5	

A - Test in Tension

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	22%	78%	Jan.27	Feb.15	19	398	
2	"	"	"	"	"	548	
3	"	"	"	"	"	460	
4	"	"	"	"	"	300	
5	"	"	"	"	"	330	
Average						407	

A - Test in Tension

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr. 20	May 11	21	450	
2	"	"	"	"	"	415	
3	"	"	"	"	"	440	
4	"	"	"	"	"	466	
5	"	"	"	"	"	375	
Average						429	

A - Test in Tension

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr. 20	May 17	27	525	
2	"	"	"	"	"	595	
3	"	"	"	"	"	410	
4	"	"	"	"	"	340	
5	"	"	"	"	"	384	
Average						450.8	

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	21.8%	78.2%	Feb. 4	Feb. 11	7	2287	
2	"	"	"	"	"	2215	
3	"	"	"	"	"	1945	
4	"	"	"	"	"	2382	
5	"	"	"	"	"	2582	
Average						2282	

B - Test in Compression (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	21.8%	78.2%	Feb. 4	Feb. 11	7	2200	
2	"	"	"	"	"	2382	
3	"	"	"	"	"	2562	
4	"	"	"	"	"	3137	
5	"	"	"	"	"	2540	
Average						2564	

B - Test in Compression (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	22%	78%	Jan.27	Feb.15	19	2345	
2	"	"	"	"	"	4056	
3	"	"	"	"	"	3855	
4	"	"	"	"	"	2822	
5	"	"	"	"	"	5107	
Average						3637	

B - Test in Compression (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	22%	8%	Jan.27	Feb.15	19	5850	
2	"	7"	"	"	"	5180	
3	"	"	"	"	"	5767	
4	"	"	"	"	"	6702	
5	"	"	"	"	"	Lost	
Average						5880	

B - Test in Compression (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr.20	May 11	21	8072	
2	"	"	"	"	"	7102	
3	"	"	"	"	"	8032	
4	"	"	"	"	"	7145	
5	"	"	"	"	"	6507	
Average						6971	

B - Test in Compression (Neat)

No.	Proportion Water	Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr. 20	May 17	27	7820	
2	"	"	"	"	"	6862.6	
3	"	"	"	"	"	6595	
4	"	"	"	"	"	6825	
5	"	"	"	"	"	7680	
Average						7156.5	

KANSAS PORTLAND

11 - - Mortar Test

A - Test in Tension

No.	Proportion Water	Sand : Cement	Date Made	Tested	Age Dys.	Strength lbs.sq.in.	Remarks
1	11%	2:1	May 18	May 25	7	220	
2	"	"	"	"	"	175	
3	"	"	"	"	"	230	
4	"	"	"	"	"	250	
5	"	"	"	"	"	175	
Average						208	

A - Test in Tension

No.	Proportion Water	Sand : Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	11%	2:1	May 18	June 1	14	275	
2	"	"	"	"	"	325	
3	"	"	"	"	"	290	
4	"	"	"	"	"	275	
5	"	"	"	"	"	350	
Average						303	

A - Test in Tension

No.	Proportion Water	Sand: Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remark
1	11.1%	2:1	Mar. 1	Mar.30	29	350	
2	"	"	"	"	"	352	
3	"	"	"	"	"	365	
4	"	"	"	"	"	345	
5	"	"	"	"	"	337	
Average						349.4/5	

B - Test in Compression

No.	Proportion Water	Sand : Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	11%	2:1	May 18	May25	7	1630	
2	"	"	"	"	"	1210	
3	"	"	"	"	"	1390	
4	"	"	"	"	"	1390	
5	"	"	"	"	"	1460	
Average						1416	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	11%	2:1	May 18	June 1	14	1680	
2	"	"	"	"	"	1980	
3	"	"	"	"	"	1800	
4	"	"	"	"	"	1830	
5	"	"	"	"	"		
Average						1822.5	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	13.16	3:1	Mar.3	Apr.8	36	2835	
2	"	"	"	"	"	2350	
3	"	"	"	"	"	2560	
4	"	"	"	"	"	3072.5	
5	"	"	"	"	"	2827.5	
Average						2720	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	11.1%	2:1	Mar.1	Apr.8	39	3070	
2	"	"	"	"	"	3085	
3	"	"	"	"	"	3380	
4	"	"	"	"	"	4045	
5	"	"	"	"	"	3087.5	
Average						3329.5	

Transverse Test

No.	Proportion Water	Cement:Sand :Gravel	Date Made	Tested	Age days	Section	Load Breaking	f Lbs.
1	13%	1:3:5	Apr. 8	Apr.29	21	6x4x12	1130	2260
2	9.35%	1:3:5	Apr.10	May 3	23	4x6x24	3280	3280
3		1:3:1	" 17	" 13	26	4x8x20	1890	3544
4		"	"	"	26	6x8x20	3710	4637.5
5		"	"	"	26	"	3890	4662.5
6		"	"	" 15	28	"	3640	4550
7		"	"	"	28	"	4050	5065.5
8		"	"	"	28	"	3650	4565.5

9	1:3:5	Apr.10	May 12	32	C	860	3440

Note. (3) and (4) of above Transverse Test were made on stone machine.

111 - Concrete Tests

Test In Compression.

No.	Proportion Sand:Cement:Gravel	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	3:1:5	Apr.10	Apr.26	16	816.25	
2	"	"	"		647	
3	"	"	"		584	
4	"	"	"		637.5	
5	"	"	"		586.25	
Average					654.1/5	

Test in Compression

No.	Proportion Water	Cement:Sand :Gravel	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	13%	1:3:5	Apr.8	Apr.29	21	702.5	
2	"	"	"	"	"	647.5	
3	"	"	"	"	"	626.875	
Average						658.96	
1	13%	"	"	May 6	28	602.5	
2	"	"	"	"	"	580.625	
3	"	"	"	"	"	710.625	
Average						631.25	

IOLA PORTLAND

Test in Tension

No.	Proportion Water	Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	May 15	May22	7	420	

2	25%	75%	May 15	May 22	7	495
3	"	"	"	"	"	410
4	"	"	"	"	"	360
5	"	"	"	"	"	360
Average						409

Test in Tension (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	May 15	May 29	14	580	
2	"	"	"	"	"	495	
3	"	"	"	"	"	590	
4	"	"	"	"	"	425	
5	"	"	"	"	"	Lost	
Average						522.5	

Test in Tension (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr.12	May 3	21	587	
2	"	"	"	"	"	535	
3	"	"	"	"	"	480	
4	"	"	"	"	"	390	
5	"	"	"	"	"	665	
Average						531.2/5	

Test in Tension (Neat)

No	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr.12	May 11	29	565	
2	"	"	"	"	"	700	
3	"	"	"	"	"	636	

4	"	"	"	"	29	710
5	"	"	"	"	"	525
Average						627

Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	May 15	May 22	7	3095	
2	"	"	"	"	"	3520	
3	"	"	"	"	"	4100	
4	"	"	"	"	"	3800	
5	"	"	"	"	"	3970	
Average						3697	

Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	May 15	May 29	14	6952.5	
2	"	"	"	"	"	4580	
3	"	"	"	"	"	7620	
4	"	"	"	"	"	5550	
5	"	"	"	"	"	6380	
Average						6216.5	

A - Test in Compression (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr. 12	May 3	21	10655	
2	"	"	"	"	"	10850	
3	"	"	"	"	"	9592	
4	"	"	"	"	"	10580	
5	"	"	"	"	"	12177	
Average						10771	

A - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr. 12	May 11	29	8088	
2	"	"	"	"	"	12090	
3	"	"	"	"	"	9768	
4	"	"	"	"	"	9580	
5	"	"	"	"	"	9075	
Average						9720	

IOLA PORTLAND

11 - - Mortar Test

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Dys.	Strength lbs.sq.in.	Remarks
1	13%	2:1	May 19	May 26	7	295	
2	"	"	"	"	"	310	
3	"	"	"	"	"	280	
4	"	"	"	"	"	300	
5	"	"	"	"	"	265	
Average						290	

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Dys.	Strength lbs.sq.in.	Remarks
1	13%	2:1	May 19	June 2	14	285	
2	"	"	"	"	"	295	
3	"	"	"	"	"	305	
4	"	"	"	"	"	340	
5	"	"	"	"	"	315	
Average						308	

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	13%	2:1	Apr.22	May15	23	320	
2	"	"	"	"	"	300	
3	"	"	"	"	"	345	Set 48 hours
4	"	"	"	"	"	295	in air
5	"	"	"	"	"	360	
Average						324	

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	13%	2:1	Apr.22	May 20	28	340	
2	"	"	"	"	"	315	
3	"	"	"	"	"	315	Set 48 hrs.
4	"	"	"	"	"	325	in air
5	"	"	"	"	"	265	
Average						312	

A - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	13%	2:1	May19	May 26	7	1775	
2	"	"	"	"	"	1925	
3	"	"	"	"	"	2295	
4	"	"	"	"	"	1850	
5	"	"	"	"	"	1910	
Average						1951	

A - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	13%	2:1	May 19	June2	14	3910	
2	"	"	"	"	"	3690	
3	"	"	"	"	"	2910	
4	"	"	"	"	"	2780	
5	"	"	"	"	"	2870	
Average						3232	

A - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	13%	2:1	Apr. 22	May 15	23	4210	Set 48
2	"	"	"	"	"	4010	hours
3	"	"	"	"	"	3940	in air
4	"	"	"	"	"	2805	
5	"	"	"	"	"	3400	
Average						3673	

A - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	13%	2:1	Apr.22	May 20	28	4080	
2	"	"	"	"	"	3485	
3	"	"	"	"	"	3855	
4	"	"	"	"	"	3380	
5	"	"	"	"	"	3550	
Average						3670	

lll - Concrete Test.

Test in Transverse

No.	Proportion Water	Cement:Sand :Gravel	Date Made	Tested	Age Days	Section	Load lbs.	f lbs.
1	9:35	1:3:5	Apr.13	May10	28	4x6x24	940	3760
2		1:2:3	" 19	" 17	"	5.5x8x29	2300	2875
3		"	"	"	"	6x8x20	2930	3662.5

Note: The above test was made in machine.

LOUISVILLE NATURAL

Cement Test

A - Test in Tension (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33.33	66.67%	May 3	May 11	8	90	
2	"	"	"	"	"	83	
3	"	"	"	"	"	72	
4	"	"	"	"	"	80	
5	"	"	"	"	"	75	
Average						80	

A - Test in Tension (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33%	67%	May 3	May17	14	115	
2	?	"	"	"	"	90	
3	"	"	"	"	"	15	
4	"	"	"	"	"	90	
5	"	"	"	"	"	105	
Average						103	

A - Test in Tension (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33.1/3%	66.2/3%	Apr.11	May 3	22	116	
2	"	"	"	"	"	130	
3	"	"	"	"	"	126	
4	"	"	"	"	"	85	
5	"	"	"	"	"	110	
Average						113.2/5	

A - Test in Tension (Neat)

No.	Proportion Water	Proportion Cements	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33.1/3%	66.1/3%	Apr. 11	May 11	30	132	
2	"	"	"	"	"	181	
3	"	"	"	"	"	127	
4	"	"	"	"	"	124	
5	"	"	"	"	"	175	
Average						148	

Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33%	67%	May 3	May 11	8	385	
2	"	"	"	"	"	440	
3	"	"	"	"	"	517.5	
4	"	"	"	"	"	500	
5	"	"	"	"	"	585	
Average						485.5	

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33⅓%	67⅔%	May 3	May 17	14	615	
2	"	"	"	"	"	625	
3	"	"	"	"	"	590	
4	"	"	"	"	"	570	
5	"	"	"	"	"	580	
Average						596	

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33.1/3%	66.2/3%	Apr.11	May 3	22	828	
2	"	"	"	"	"	865	
3	"	"	"	"	"	950	
4	"	"	"	"	"	927	
5	"	"	"	"	"	980	
Average						910	

B- Test in Compression.

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33.1/3%	66.2/3%	Apr.11	Mayll	30	1732	
2	"	"	"	"	"	1472	
3	"	"	"	"	"	1262	
4	"	"	"	"	"	1430	
5	"	"	"	"	"	1232	
Average						1426	

A - Test in Tension ll -Mortar Test.

No.	Proportion Water	Proportion Sand:Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	Mayl8	May25	7	24	
2	"	"	"	"	"	22	
3	"	"	"	"	"	21	
4	"	"	"	"	"	27	
5	"	"	"	"	"	28	
Average						24.4	

A - Test in Tension

No.	Proportion Water	Proportion Sand:Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	Mayl8	Junel	14	33	
2	"	"	"	"	"	35	
3	"	"	"	"	"	28	
4	"	"	"	"	"	32	
5	"	"	"	"	"	28	
Average						31.2	

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	2:1	Apr.19	Mayll	22	58	
2	"	"	"	"	"	58	
3	"	"	"	"	"	62	
4	"	"	"	"	"	58	
5	"	"	"	"	"	53	
Average						58	

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	2:1	Apr.19	Mayl7	28	97	
2	"	"	"	"	"	78	
3	"	"	"	"	"	80	
4	"	"	"	"	?	65	
5	"	"	"	"	"	Lost	
Average						80	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	May 18	May 25	7	65	
2	"	"	"	"	"	50	
3	"	"	"	"	"	70	
4	"	"	"	"	"	100	
5	"	"	"	"	"	105	
Average						78	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	May 18	June 1	14	160	
2	"	"	"	"	"	150	
3	"	"	"	"	"	140	
4	"	"	"	"	"	130	
5	"	"	"	"	"	150	
Average						146	

11 - - Mortar Test.

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	2:1	Apr. 19	May 11	22	435	
2	"	"	"	"	"	455	
3	"	"	"	"	"	552.5	
4	"	"	"	"	"	487.5	
5	"	"	"	"	"	440	
Average						474	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	2:1	Apr.19	May17	28	697.5	
2	"	"	"	"	"	700	
3	"	"	"	"	"	575	
4	"	"	"	"	"	590	
5	"	"	"	"	"	590	
Average						630.5	

111 - Concrete Test.

Test in Compression

No.	Proportion Water	Cement:Sand :Gravel	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	29%	1:3:5	Apr.12	Apr.2	14	20.625	

FORT SCOTT NATURAL (2)

A - Test in Tension (Neat)

No.	Proportion Water	Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33%	67%	May 5	May 12	7	45	
2	"	"	"	"	"	40	
3	"	"	"	"	"	32	
4	"	"	"	"	"	33	
5	"	"	"	"	"	Lost	
Average						37.5	

A - Test in Tension

No.	Proportion Water	Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33%	67%	May 5	May 19	14	33	
2	"	"	"	"	"	42	
3	"	"	"	"	"	38	
4	"	"	"	"	"	50	
5	"	"	"	"	"	Lost	
Average						40.75	

Fort Scott Natural (Direct from plant)

A - Test in Tension (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	30%	70%	Apr.19	May 11	22	35	No.s 3 & 5
2	"	"	"	"	"	32	broke in be-
3	"	"	"	"	"	X	ing put into
4	"	"	"	"	"	33	testing mach-
5	"	"	"	"	"	X	ine.
Average						33.1/3	

A - Test in Tension (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	30%	70%	Apr.19	May17	28	40	
2	"	"	"	"	"	45	
3	"	"	"	"	"	45	
4	"	"	"	"	"	40	
5	"	"	"	"	"	Lost	
Average						42.5	

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33%	67%	May 5	May12	7	165	
2	"	"	"	"	"	140	
3	"	"	"	"	"	160	
4	"	"	"	"	"	130	
5	"	"	"	"	"	115	
Average						142	

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	33%	67%	May 5	May 19	114	100	
2	"	"	"	"	"	125	
3	"	"	"	"	"	145	
4	"	"	"	"	"	127.5	
5	"	"	"	"	"	120	
Average						123.5	

Fort Scott Natural (From plant)

B - Test in Compression (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	30%	70%	Apr.19	May11	22	247	
2	"	"	"	"	"	428	
3	"	"	"	"	"	132	
4	"	"	"	"	"	150	
5	"	"	"	"	"	215	
Average						234.2/5	

B - Test in Compression.

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	30%	70%	Apr.19	May17	28	277.5	
2	"	"	"	"	"	205	
3	"	"	"	"	"	240	
4	"	"	"	"	"	255	
5	"	"	"	"	"	250	
Average						245.5	

11 - - Mortar Test

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	May17	May24	7	13	
2	"	"	"	"	"	18	
3	"	"	"	"	"	16	
4	"	"	"	"	"	17	
5	"	"	"	"	"	16	
Average						16	

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	May 17	May31	14	22	
2	"	"	"	"	"	12	
3	"	"	"	"	"	22	
4	"	"	"	"	"	27	
5	"	"	"	"	"		
Average						16.6	

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	Apr.26	May17	21	20	
2	"	"	"	"	"	17	
3	"	"	"	"	"	20	
4	"	"	"	"	"	18	
5	"	"	"	"	"	15	
Average						18	

A - Test in Tension

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	Apr.26	May 24	28	15	
2	"	"	"	"	"	17	
3	"	"	"	"	"	20	
4	"	"	"	"	"	20	
Average	"	"	"	"	"	18	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	28%	2:1	May 17	May 24	7	50	
2	"	"	"	"	"	40	
3	"	"	"	"	"	40	
4	"	"	"	"	"	20	
5*	"	"	"	"	"	40	
Average						38	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	28%	2:1	May 17	May 31	14	100	
2	"	"	"	"	"	100	
3	"	"	"	"	"	120	
4,	"	"	"	"	"	90	
5	"	"	"	"	"	90	
Average						100	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	Apr.26	May 17	21	60	
2	"	"	"	"	"	87.5	
3	"	"	"	"	"	75	
4	"	"	"	"	"	80	
5	"	"	"	"	"	70	
Average						74.5	

B - Test in Compression

No.	Proportion Water	Sand:Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	18%	2:1	Apr.26	May 24	28	60	
2	"	"	"	"	"	100	
3	"	"	"	"	"	50	
4	"	"	"	"	"	60	
5	"	"	"	"	"	90	
6	"	"	"	"	"	90	
Average						75	

Fort Scott Natural (As bought from Pfuetze Bros.)

A - Test in Tension (Neat)

No.	Proportion Water	Cement	Date Made	Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr. 14	May 5	21	395	
2	"	"	"	"	"	455	
3	"	"	"	"	"	388	
4	"	"	"	"	"	355	
5	"	"	"	"	"	299	
Average						376/3/5	

A - Test in Tension

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength Lbs.sq.in.	Remarks
1	25%	75%	Apr.14	May12	28	465	
2	"	"	"	"	"	320	
3	"	"	"	"	"	432	
4	"	"	"	"	"	375	
5	"	"	"	"	"	220	
Average						362.2/5	

B - Test in Compression (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr.14	May 5	21	3102	
2	"	"	"	"	"	2575	
3	"	"	"	"	"	3285	
4	"	"	"	"	"	2525	
5	"	"	"	"	"	2392	
Average						2776	

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	Apr. 14	May 12	28	4040	
2	"	"	"	"	"	4022	
3	"	"	"	"	"	3598	
4	"	"	"	"	"	3417	
5	"	"	"	"	"	4035	
Average						3822.2/5	

Concrete Tests

Test in Transverse

No.	Proportion Cement:Sand:Gravel	Date Made	Date Tested	Age Days	Section	Load Break	f lbs.
1	1:2:2	Apr. 19	May 17	28	6x8x20	2180	2725

Note: The above Transverse Test was made in machine.

ATLAS PORTLAND

A - Test in Tension (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	May 5	May 12	7	300	
2	"	"	"	"	"	244	
3	"	"	"	"	"	458	
Average						334	

A - Test in Tension (Neat)

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	May 5	May 19	14	240	
2	"	"	"	"	"	280	
3	"	"	"	"	"	330	
4	"	"	"	"	"	350	
Average						300	

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	May 5	May 12	7	1475	
2	"	"	"	"	"	1322.5	
3	"	"	"	"	"	1812.5	
4	"	"	"	"	"	1525	
5	"	"	"	"	"	1577.5	

Average 1542.5

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	25%	75%	May 5	May19	14	1717.5	
2	"	"	"	"	"	1562.5	
3	"	"	"	"	"	1765	
4	"	"	"	"	"	2000	
5	"	"	"	"	"	1995	
Average						1808	

RED RING PORTLAND

A - Test in Tension

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	21%	79%	May 8	May 15	7	265	
2	"	"	"	"	"	300	
3	"	"	"	"	"	220	
4	"	"	"	"	"	310	
5	"	"	"	"	"	245	
Average						268	

A - Test in Tension

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	21%	79%	May 8	May 22	14	285	
2	"	"	"	"	"	320	
3	"	"	"	"	"	313	
4	"	"	"	"	"	322	
5	"	"	"	"	"	265	
Average						301	

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	21%	79%	May 8	May 15	7	2200	
2	"	"	"	"	"	1790	
3	"	"	"	"	"	2055	
4	"	"	"	"	"	1880	
5	"	"	"	"	"	2505	
Average						2086	

B - Test in Compression

No.	Proportion Water	Proportion Cement	Date Made	Date Tested	Age Days	Strength lbs.sq.in.	Remarks
1	21%	79%	May 8	May 22	14	2310	
2	"	"	"	"	"	2490	
3	"	"	"	"	"	1750	
4	"	"	"	"	"	2560	
5	"	"	"	"	"	2360	
Average						2298	

COMPARATIVE TABLE OF NEAT CEMENTS.

A - Tension in pounds per square inch.

Brand	7 Days	14 Days	21 Days	28 Days
Kans. Portland	273.1/2	461.2/5	429	45.8
Iola Portland	409	522.1/2	531.2/5	627
Ft. Scott Nat.(1)			376.3/5	362.2/5
Louisville Nat.	24.4	103.	113.2/5	148
Ft. Scott Nat.(2)	36.1/3	40.75	33.1/3	42.5
Arlas Portland	334.	300.		
Red Ring Port.	268.	301.		

B - Compression in pounds per square inch.

Brand	7 Days	14 Days	21 Days	28 Days
Kans. Portland	2423	4758.1/2	6791	7156.5
Iola Portland	3697	6216.5	10771	9720.
Ft. Scott Nat.(1)			2776	3822.2/5
Louisville Nat.	485.5	596	910	1426
Ft. Scott Nat.(2)	142.	123.5	234.2/5	245.5
Atlas Portland	1542.5	1808		
Red Ring Portland	2086	2298		

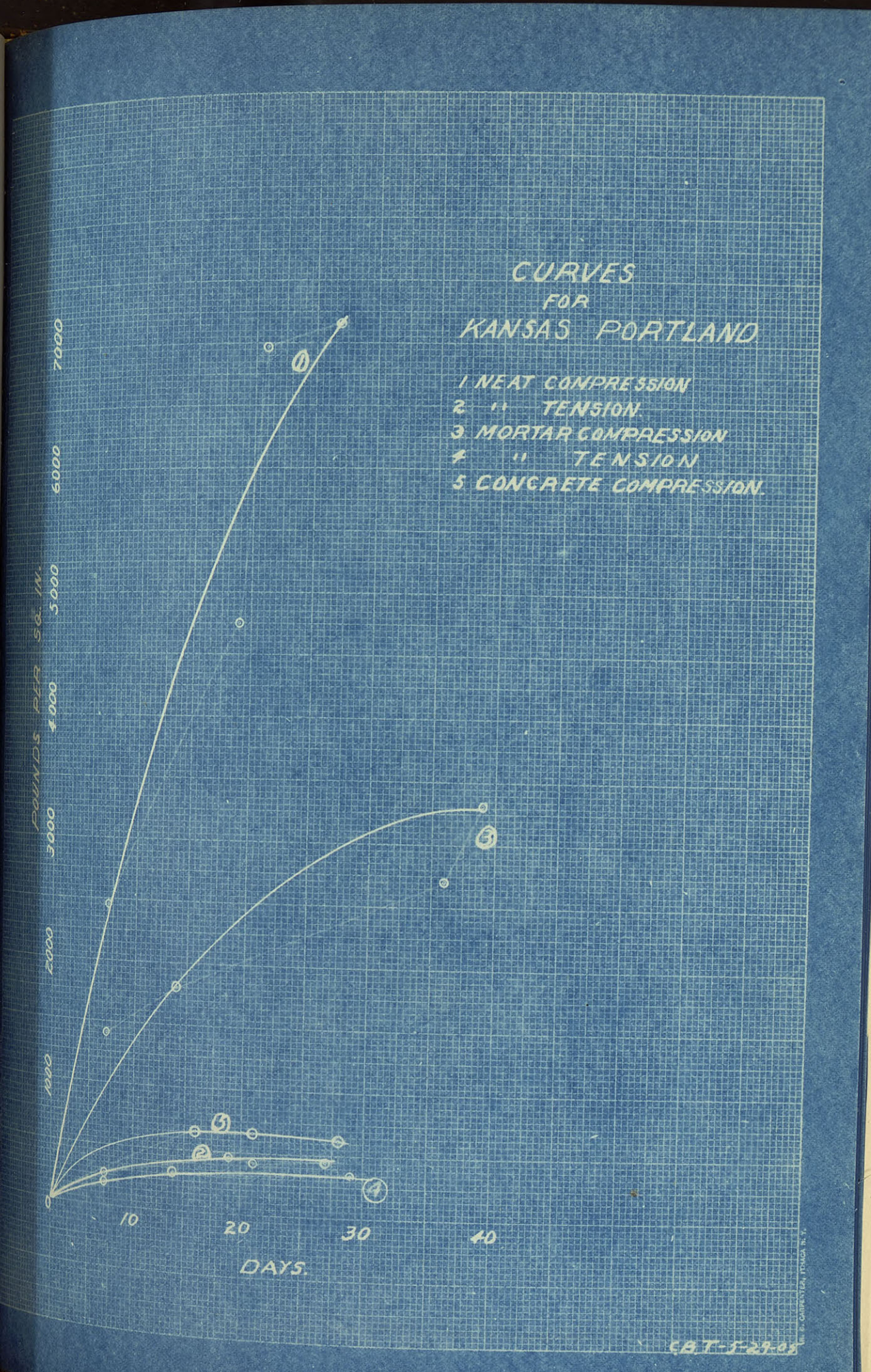
COMPARATIVE TABLE OF MORTAR TESTS.

A - Tests in pounds per square inch Tension.

Brand	7 Days	14 Days	21 Days	28 Days
Kans. Portland	208	303		349.8
Iola Portland	290	308	324	312.
Louisville Nat.	24.4	31.2	58	80.
Ft. Scott Nat.	16.	16.6	18	18.

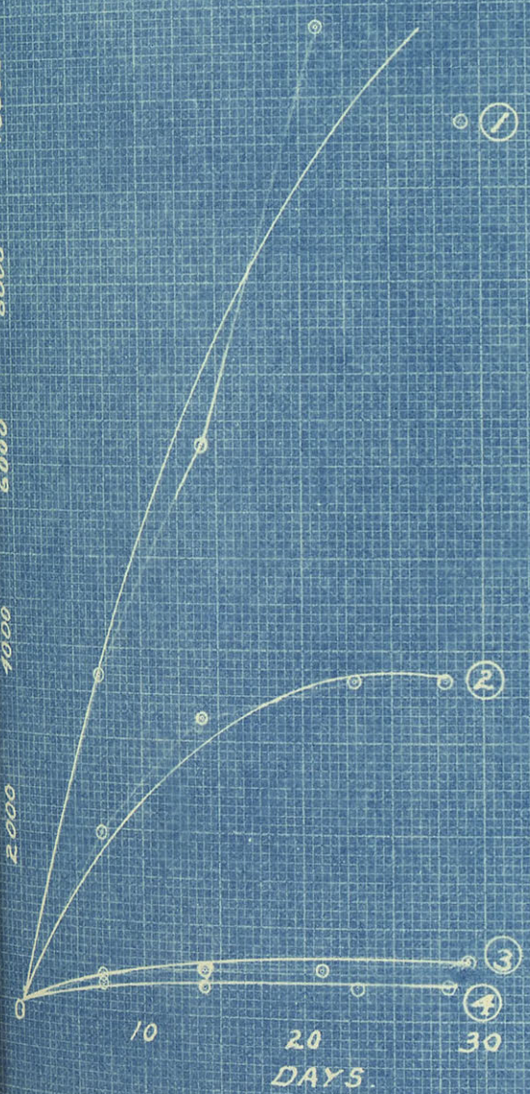
B - Tests in pounds per square inch Compression.

Brand	7 Days	14 Days	21 Days	28 Days
Kans. Portland	1416	1822.1/2		
Iola Portland	1951	3232	3673	3670
Louisville Nat.	78	146	474	630.5
Ft. Scott Nat.	38	100	74.6	75.

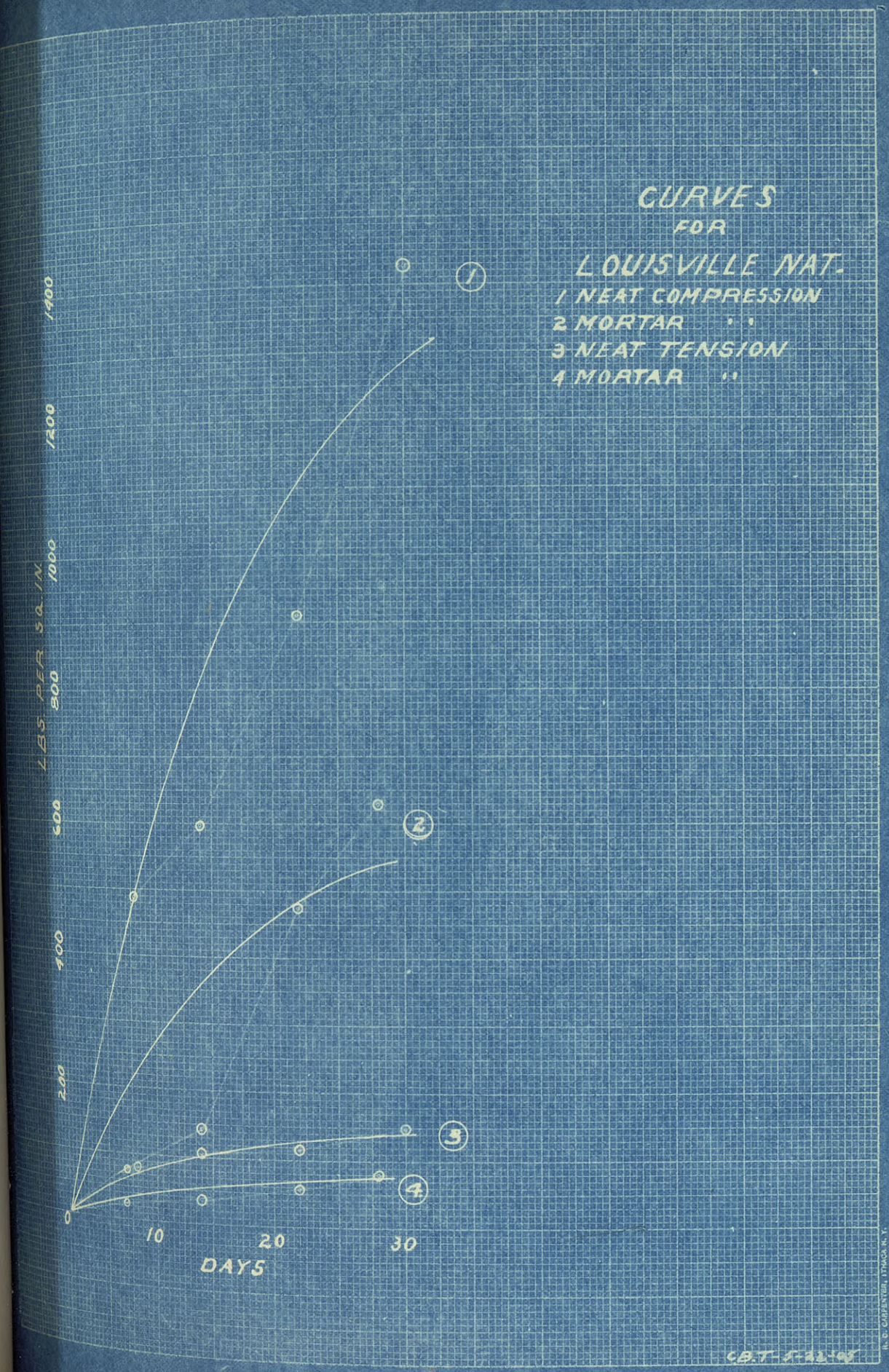

CURVES
FOR
KANSAS PORTLAND
1 NEAT COMPRESSION
2 " TENSION
3 MORTAR COMPRESSION
4 " TENSION
5 CONCRETE COMPRESSION.
POUNDS PER SQ. IN.
1000
2000
3000
4000
5000
6000
7000
10
20
30
40
DAYS.
C.A.T. 5-29-05

CURVES FOR IOLA PORT.

1 NEAT COMPRESSION.
2 MORTAR "
3 NEAT TENSION
4 MORTAR "

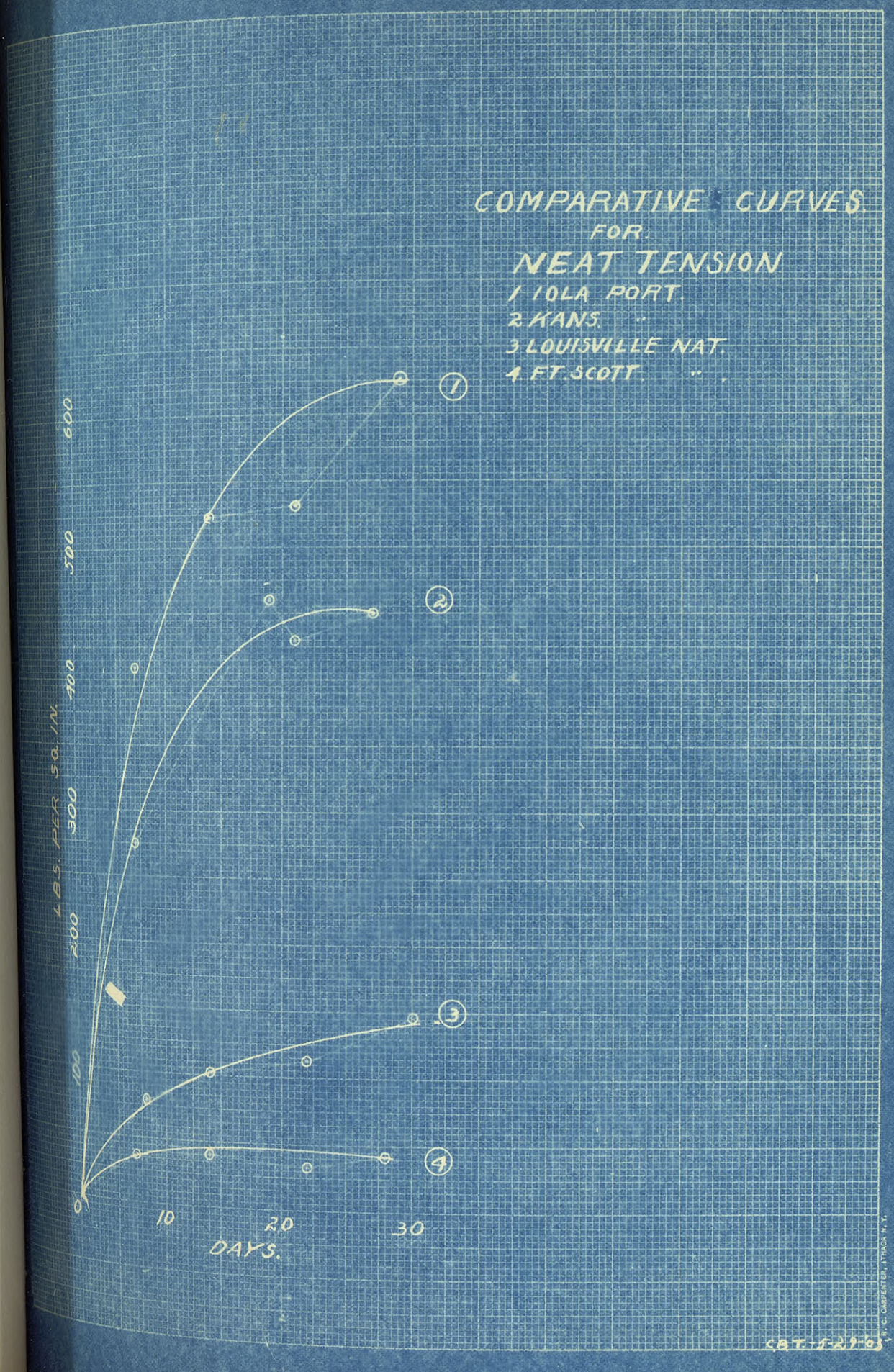


CAT-5-29-05


CURVES
FOR
LOUISVILLE NAT.
1 NEAT COMPRESSION
2 MORTAR "
3 NEAT TENSION
4 MORTAR "
LBS. PER SQ. IN.
200
400
600
800
1000
1200
1400
10
20
30
DAYS
1
2
3
4
C.B.T. 5-22-04
R. D. CARPENTER, ITHACA N.Y.

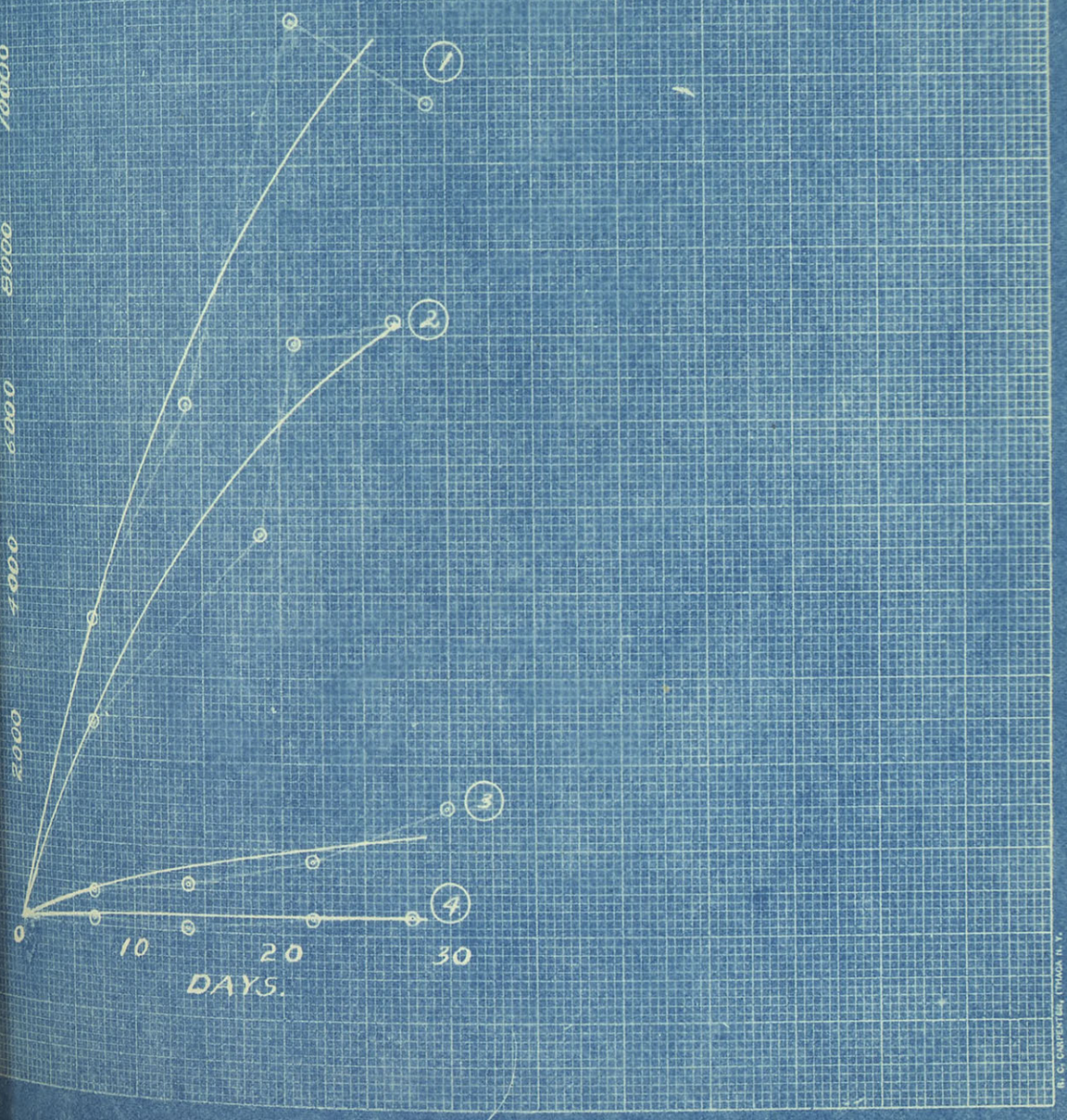
CURVES FOR FT. SCOTT NAT.

1 NEAT COMPRESSION
2 MORTAR "
3 NEAT TENSION
4 MORTAR "


COMPARATIVE CURVES
FOR
NEAT TENSION
1 IOLA PORT.
2 KANS. "
3 LOUISVILLE NAT.
4 FT. SCOTT. "
LBS. PER SQ. IN.
100
200
300
400
500
600
10
20
30
DAYS.
1
2
3
4
C.B.T. 5-21-03
R. C. CARPENTER, ITHACA N.Y.

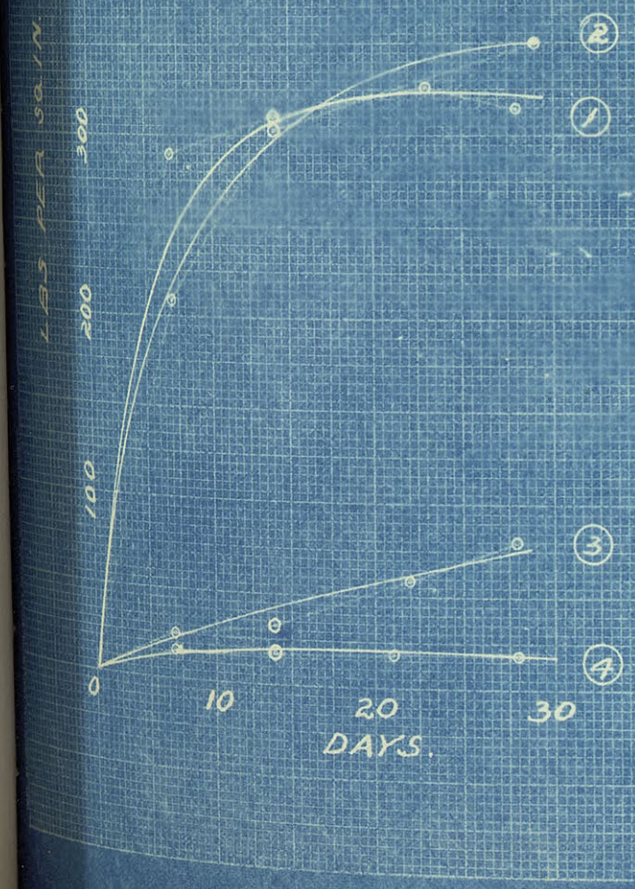
COMPARATIVE CURVES FOR NEAT COMPRESSION

1 IOLA PORTLAND.
2 KANS. "
3 LOUISVILLE NAT.
4 FT. SCOTT. "



COMPARATIVE CURVES
FOR
MORTAR TENSION

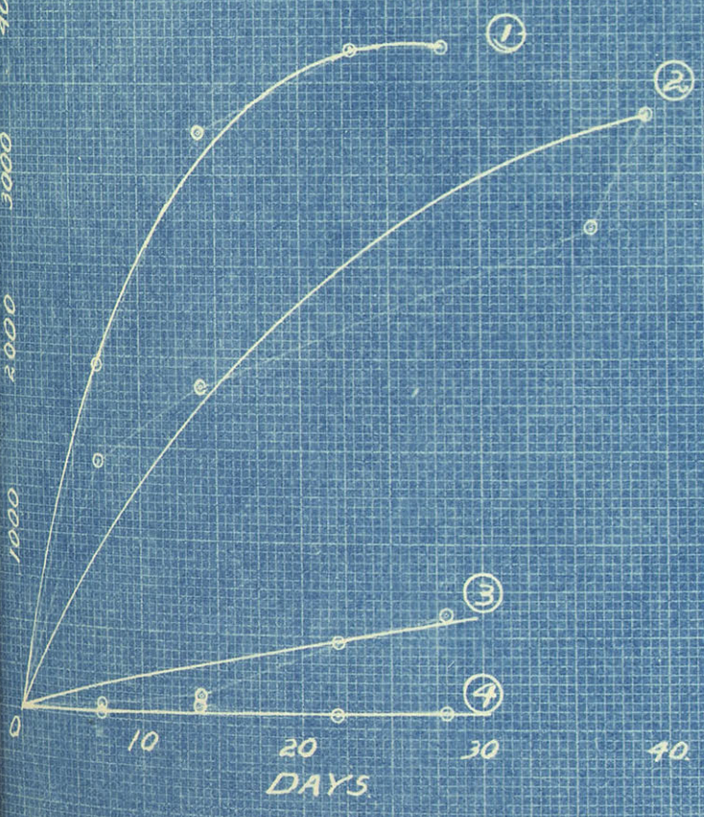
1. IOLA PORT.
2. KANS "
3. LOUISVILLE NAT.
4. FT. SCOTT "



C.B.T.-5-29-01

COMPARATIVE CURVES FOR MORTAR COMPRESSION

1 IOLA PORT.
2 KANS. "
3 LOUISVILLE NAT.
4 FT. SCOTT "



C.B.T. 3-29-05

In all of the foregoing results there are sources of or circumstances by means of which errors might have occured. Among them are (1), Unevenness of temperature of the surrounding atmosphere and of the bath. (2) Uneveness of the distribution of the water in the mixing, more especially of the Natural Cements, as they are very rapid in setting and hence require that the mixing should be done as quickly as possible. (3) Condition of the atmosphere during the first 24 hours of setting as regards dampness. (4) There might have been some difference in the solidity to which the briquettes were packed. (5) In the testing there may have been uneven pressure due to uneven surfaces.

Of all the possibilities the last is possibly the greatest, hence the most likely source of error. In some of the tension moulds the dimensions were slightly large, hence the briquettes required slight dressing down in order to fit into the testing machine and a few were broken in trying to force them into the clamps when they were slightly too large.

In the Kansas Portland, the curves show an almost steady rise in strength for both the neat and the mortar in both tension and compression, although there are some variations from the general curve. The Kansas Portland was tested in concrete more than any other brand and some very good results were obtained, it doing almost twice as well as some of the others neat.

The Iola Portland show about the same general r esults as the Kansas Portland with the one exception that it seems to have reached its maximum value in neat compression at the end of three weeks, and then to have suddenly lost its strength, but this was probably due to one of the above errors.